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AIR QUALITY IMPLEMENTATION PLAN FOR THE STATE OF ALASKA

VOLUME V: SURVEILLANCE SYSTEM

DECEMBER 1971

Prepared for the

STATE OF ALASKA
DEPARTMENT OF ENVIRONMENTAL CONSERVATION

TRW
SYSTEMS GROUP

ONE SPACE PARK • REDONDO BEACH, CALIFORNIA 90278

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1.0 OVERVIEW

Air quality sampling instruments, if operated on a regular schedule with consistent sampling and analytical procedures, will produce data to allow long-term trends and short-term excursions in air pollutant levels to be identified. By proper location of samplers, maximal and minimal (background) concentrations can be quantified, as well as pollutant levels near centers of population, hospitals, or other areas of interest. During unfavorable meteorological conditions, i.e., air pollution episodes, the surveillance system must provide information on which to base source emission reduction decisions.

Paragraph 420.17 of the August 14, 1971, Federal Register, "Requirements for Preparation, Adoption and Submittal of Implementation Plans," enumerates the EPA requirements concerning state air quality surveillance networks and is quoted below:

> 420.17 Air quality surveillance.
>
> (a) (1) The plan shall provide for the establishment of an air quality surveillance system which shall be completed and in operation as expeditiously as practicable, but not later than 2 years after the date of the Administrator's approval of the plan, and which shall meet, as a minimum, the following requirements:
>
> (2) At least one sampling site must be located in the area of estimated maximum pollutant concentrations.
>
> (b) The plan shall include a description of the existing and proposed air quality surveillance system, which shall set forth:
>
> (1) The basis for the design of the surveillance system, selection of samplers, and sampling sites.

(2) The locations of the samplers by Universal Transverse Mercator (UTM) grid coordinates or the equivalent. Any EPA monitoring stations may be designated as a sampler location.

(3) The sampling schedules.

(4) The methods of sampling and analysis.

(5) The method of data handling and analysis procedures.

(6) The timetable for the installation of any additional equipment needed to complete the system.

(c) The plan shall provide for monitoring of air quality during any air pollution emergency episode stage. The stations selected during such periods must be in operation within 1 year after the date of the Administrator's approval of the plan and be capable of indicating when pollutant concentrations have reached, or are approaching, any episode criteria established pursuant to Para. 420.16.

Additional information in considerably more detail is contained in Document AP-98, "Guidelines: Air Quality Surveillance Networks," published by the Environmental Protection Agency. The recommendations for number of samplers in this document generally are higher than those defined as minimum legal requirements in the August 14, 1971, Federal Register.

Air pollution problems in the State of Alaska are more complex than in many other parts of the world. Alaska is geologically composed of glacial deposits which are, in many areas, composed of gravel and fine sand rather than clay. This type soil tends to extreme dustiness when disturbed during dry climatological conditions. The nature of the soil may be the principal causative factor for the elevated suspended particulate

measurements in the state, but this cannot be definitely stated without considerable study. Section 6.0 of this report discusses a series of special studies which will provide insight into this matter, and may ultimately lead to the definition of particulate control strategies which will reduce the burden of suspended particulate matter in the air.

The climatology of the State of Alaska is unique in the United States because of the arctic conditions which prevail over most of the state. Extended periods of stagnant air conditions occur, particularly in the winter. Anti-cyclonic conditions tend to persist for periods of a few days to one or two weeks. During these periods, any air pollutants generated will be trapped in a small volume of air, and the elevated concentrations of pollutants which develop do not decrease until the air stagnation conditions change naturally. Elevated carbon monoxide concentrations have been measured in Fairbanks.

Sections 2.0, 3,0 and 4.0 of this document contain descriptions of the existing air pollution control programs in the State of Alaska, detailed discussions of the existing air quality data, and a definition of an air quality surveillance program which will meet the minimum federal requirements as defined by the Federal Register. Section 5.0 defines the procedures which will be used in sample collection, sample analysis, and data handling.

The principal purposes of an air quality surveillance program are to show how air quality compares with regulatory standards and to indicate trends in air pollutant concentrations. In the State of Alaska, it is equally important that the air quality monitoring program define

the existing problems in such detail that cause-and-effect relationships can be developed to both solve existing problems and prevent the perpetuation of the problems in the future. Section 6.0 addresses this aspect of the air quality surveillance program.

2.0 COOK INLET INTRASTATE AIR QUALITY CONTROL REGION #008

2.1 EXISTING PROGRAM AND AIR QUALITY DATA

The National Air Surveillance Network (NASN) has measured suspended particulates in Anchorage since 1953. The high volume sampler has been operated at three different locations, as noted in Table 2.1. From 1958 through 1962, an additional NASN high volume sampler was operated at an FAA remote receiver on Point Woronzof, at the tip of the Anchorage Peninsula.

During calendar year 1969, Anchorage was a sampling station for the NASN Interstate Effects Surveillance Network, a static air pollution effects sampling program. Metal corrosion, fabric discoloration, silver tarnishing, sulfation, dustfall, nylon deterioration, rubber cracking, and windblown particulates were evaluated. The effects package was located adjacent to the NASN high volume sampler on the roof of the two-story building at 527 E. 4th Street.

For a one-year period between September, 1967, and September, 1968, the Arctic Health Research Center of the U. S. Public Health Service conducted an air quality study at Elmendorf Air Force Base in Anchorage. Four sampling sites on the base were evaluated for suspended particulates, nitrogen dioxide by the Saltzman

TABLE 2.1

National Air Surveillance Network Data for Anchorage

Pollutant	Location (Height)*	Sampling Interval (mo)	Start Date	End Date	No. of Samples	24-Hr. Max.	Geo. Mean	Geo. Std. Dev.
TSP $\mu g/m^3$	Anchorage NASN	12	01/54	12/54	48	3112	214	2.43
	City Fire Hall (15 feet)	12	01/55	12/55	34	703	165	3.02
	6th & K St. (26 feet)	12	01/16/57	12/29/57	26	338	144	2.12
		12	01/14/58	12/29/58	26	487	106	2.19
		12	01/14/59	12/28/59	25	281	65	2.07
		12	01/30/60	12/21/60	26	269	74	2.19
		12	01/22/61	12/04/61	25	243	54	1.98
		12	01/27/62	12/22/62	25	165	69	1.57
		12	01/03/63	12/19/63	27	234	51	2.38
		12	01/08/64	12/16/64	24	342	68	2.79
	527 E. 4th (26 feet)	12	01/16/67	12/21/67	24	320	69	2.36
		12	01/12/68	12/16/68	26	190	60	2.21
		12	01/04/69	12/16/69	25	268	79	2.30
		12	01/03/70	12/12/70	24	258	72	2.21
	Pt. Woronzof	12	01/11/58	12/26/58	23	83	18	2.04
	FAA Remote Site (5 feet)	12	01/04/59	12/18/59	25	54	13	2.02
		12	01/02/60	12/22/60	26	48	15	2.07
		12	01/04/61	12/19/61	26	45	11	2.08
		12	01/09/62	12/24/62	25	125	12	2.29

*elevation of sampler inlet above ground

technique, total nitrogen oxides by the Saltzman technique, sulfur dioxide by the West-Gaeke technique, aldehydes by the MBTH method and ammonia by the Nesslerization method. Pertinent data are presented in Table 2.2.

The Tri-Borough Air Resources Management District began an air quality surveillance program in 1969. This program is currently operating high volume samplers at 15 sites within the region, and is the operator for the NASN sampler. These sampling locations are listed in Table 2.3. These locations are indicated on the maps presented in Section 1 of the Control Strategy Volume.

Suspended particulate data are shown in Table 2.4. The high school sites are not included because only limited cooperation was received in changing samples, and there were too few samples for valid statistical treatment.

During 1969, a six-month study of dustfall was conducted at twenty locations in Anchorage. The levels are high compared to most urban areas in the lower 48 states. A point of reference is an opinion study conducted in Birmingham, Alabama (published in the March, 1967, issue of the Journal of the Air Pollution Control Association) where interviews with 7,200 households indicated that half the population considered dustfall a nuisance at 40 $T/mi^2/mo$ and one-third of the population considered it a nuisance at 30 $T/mi^2/mo$. The dustfall levels determined in Anchorage, Table 2.5, are frequently above these values.

A detailed analysis of the correlation of suspended particulates with climatological factors is presented in the Control Strategy Volume. It shows that suspended particulate concentrations are higher on dry days than on wet days, relatively insensitive to wind speed, somewhat sensitive to wind direction at some sampling sites, and increase as the temperature raises above freezing.

A comparison of the data from the NASN sampler and the City Fire Station sampler, which are both in downtown Anchorage, suggests that the elevation of the sampler above ground may have a strong influence on the reported data. The Tri-Borough sampler located at the City Fire Station reported mean values of 124 and 53 $\mu g/m^3$ for dry and wet days, respectively. The NASN results for dry and wet days were 82 and 66 $\mu g/m^3$, respectively. The ratios of suspended particulate concentration for dry and wet days are 2.34 for the City Fire Station data and 1.28 for the NASN data. The sampler elevation at the City Fire Station is five feet, and at the NASN site it is 26 feet. These data are tabulated in Appendix 2-A of the Control Strategy Volume.

TABLE 2.2

Arctic Health Research Center Study Data

Pollutant	Location (Height)*	Sampling Interval (mo.)	Start Date	End Date	No. of Samples	24-Hr. Max.	Geo. Mean	Geo. Std. Dev.
TSP $\mu g/m^3$	Elmendorf AFB: Firehouse (5 feet)	12	09/14/67	09/26/68	15	270	84	2.98
SO_2 $\mu g/m^3$		12			17	5	--	--
NO_2 $\mu g/m^3$		12			15	51	18	1.91
TSP $\mu g/m^3$	Bldg. 31-270 (5 feet)	12	09/14/67	09/26/68	14	152	55	2.47
SO_2 $\mu g/m^3$		12			14	9	--	--
NO_2 $\mu g/m^3$		12			14	33	17	1.90
TSP $\mu g/m^3$	At "Top Cover" Sign (5 feet)	12	09/14/67	09/26/68	14	173	58	2.27
SO_2 $\mu g/m^3$		12			16	6	--	--
NO_2 $\mu g/m^3$		12			12	47	15	2.14
TSP $\mu g/m^3$	At Diesel Plant (5 feet)	12	09/14/67	09/26/68	16	321	79	2.73
SO_2 $\mu g/m^3$		12			18	7	--	--
NO_2 $\mu g/m^3$		12			17	81	14	2.18

*elevation of sampler inlet above ground

TABLE 2.4

Tri-Borough Air Resources Management District Suspended Particulate Data

Pollutant	Location (Height)*	Sampling Interval (mo.)	Start Date	End Date	No. of Samples	24-Hr. Max.	Geo. Mean	Geo. Std. Dev.
TSP $\mu g/m^3$	Anchorage:							
	Muldoon Fire Station (5')	12	03/19/69	03/06/70	99	358	97	2.71
		12	03/21/70	03/05/71	124	413	55	1.94
	Sand Lake Fire Station (5')	12	03/25/69	03/24/70	101	503	80	2.99
	City Fire Station (5')	12	03/25/69	03/19/70	134	312	86	2.05
		12	03/21/70	03/15/71	128	371	104	2.06
	Tudor Fire Station (5')	12	03/21/70	03/15/71	124	255	62	1.91
	Matanuska Valley Exp. Farm (5')	12	01/20/70	01/08/71	39	586	52	3.44
	Palmer Agric. Bldg. (5')	12	01/20/70	01/08/71	45	2020	55	4.67
	Nikiski-Phillips Plant (5')	12	01/13/70	01/12/71	39	68	16	1.94
	Kenai Borough Office (5')	12	01/13/70	01/12/71	38	246	52	2.77

*elevation of sampler inlet above ground

TABLE 2.5

Tri-Borough Air Resources Management District
Dustfall Study Data

Location	1969 Dustfall, Tons/Mi^2/Mo.					
	June	July	Aug.	Sept.	Oct.	Nov.
3rd & Eagle	15	21	18	22	23	25
10th & Hyder	85	68	77	160	106	36
Airport Dr. & DeBarr	29	lost	32	42	52	lost
Mt. View & Commercial	20	43	29	32	41	13
Hoyt & Thompson	28	lost	17	lost	lost	lost
Muldoon Fire Station	23	9	lost	45	28	18
16th & Ermine	45	52	12	20	28	lost
Henning Way & Debora	6	28	13	10	lost	9
N. Lights & Boniface	12	98	52	79	109	55
Dog Pound	74	16	8	34	5	5
Lake Otis & Tudor	43	35	30	10	38	17
Lake Otis & No. Lights	46	lost	37	60	48	23
C St. & N. Lights	41	52	33	60	48	24
Arctic & Chugac Dr.	164	56	44	50	39	14
Wilson Way & 46th	24	28	23	16	18	9
Sand Lake Fire	47	14	8	78	8	2
Spenard & Northwood	45	63	38	77	70	23
N. Lights & Barbara	16	27	18	30	26	13
20th & Arctic	21	34	17	17	9	6
7th & C	void	22	13	14	18	10

Reentrained street dust is thought to contribute to this difference in results. The special studies described in Section 6.0 address this subject directly.

The Tri-Borough Air Resources Management District has a current equipment inventory of 17 high volume samplers, 15 high volume sampler shelters, one high volume sampler calibrator, three MRI portable weather stations, three AISI tape samplers, one manual spot evaluator, two RAC #2333A bubblers, one spirometer, and one Mark 2 visible emission training smoke generator. A laboratory with a fume hood and approximately 25 feet of bench space is in use. The laboratory is equipped with a spectrophotometer, analytical balance and a standard assortment of laboratory ware.

2.2 REGIONAL CLASSIFICATION

The Cook Inlet Intrastate Air Quality Control Region is classified as priority I for suspended particulates on the basis of a 1970-71 annual geometric mean suspended particulate concentration of 104 $\mu g/m^3$ measured at the City Fire Station. The classification for all other pollutants is priority III, based on the Arctic Health Research Center study at Elmendorf Air Force Base and the fact that the "urban place" population does not exceed 200,000.

Based on the population and these classifications, the minimum requirements for air quality surveillance as defined in the August 14, 1971, Federal Register are:

For particulate matter, five high volume samplers collecting one 24-hour sample every sixth day, and one tape sampler collecting 2-hour samples continuously.

For sulfur dioxide, one bubbler collecting one 24-hour sample every sixth day.

2.3 MINIMUM REQUIREMENTS SURVEILLANCE SYSTEM

Major considerations in the design of a surveillance system are the location of high population density areas, the pattern of emission sources, and the distribution of samplers to provide air quality monitoring in all portions of the region.

Major point sources (>100 tons/year uncontrolled emissions) for the Cook Inlet Intrastate Air Quality Control Region are given in Table 2.6. It can be seen from the inventory that the point sources in this region are concentrated in the Anchorage and Kenai political jurisdictions. Airports are the major sources of carbon monoxide and SO_2 in this region. Emission sources for particulates, SO_2, and carbon monoxide only are given in Table 2.6. Hydrocarbon and nitrogen oxides sources are not of immediate concern. More detailed information on all sources is given in the Air Emissions Inventory for the State of Alaska, Appendix I. The locations of major point sources are indicated on mazes in the Control Strategy Volume.

Downtown Anchorage is identified as the location for a sampling site in the area of estimated maximum suspended particulate concentration. This is the area of maximum population density within the region.

TABLE 2.6

Major Emission Sources (100 Tons/year)
Region 008 - Cook Inlet Intrastate

Pollutant	Source No. (Inventory)	Source Name	Political Jurisdiction*	Current Emissions (T/yr)	Emissions (T/yr) Controlled
Particulate	1	Anchorage Int'l. Airport	1	550	
	30	McArthur River-Union/A	2	107	
	69	Elmendorf AFB	1	257	
	72	Collier Carbon & Chem.	2	201	2
SO_2	1	Anchorage Int'l. Airport	1	168	
	29	Merrill Airport	1	130	
CO	1	Anchorage Int'l. Airport	1	2310	
	27	Hood Airport	1	140	
	29	Merrill Airport	1	771	
	69	Elmendorf AFB	1	577	
	76	Atlantic-Richfield Spark Platform	2	216	

*1. Anchorage Borough
2. Kenai Borough

The sampling system will include sampling sites in the industrial area of the Kenai Peninsula and in the agricultural area near Palmer to provide surveillance in the region. A sampler will be located in a lightly populated area of the city of Anchorage to provide background information. Two sampling sites will be operated within the city of Anchorage to allow the determination of trends in suspended particulate concentrations in the most populous portion of the region.

In order to meet the minimum requirements consistent with the design basis as described above, sampling sites will be as follows:

Kenai Peninsula--the existing sampling location at the Phillips Petroleum Company plant.

Palmer--the present sampling site at the Matanuska Valley experimental farm.

Anchorage City Background--a location on Trails' End Road, about 8 miles southeast of downtown Anchorage and somewhat elevated from the Anchorage Peninsula plateau.

Downtown Anchorage--the NASN sampler at 527 E. 4th Street.

Anchorage Second Site--the offices of the Tri-Borough Air Resources Management District on Tudor Road.

The tape sampler will be operated at the Health Department building adjacent to the NASN sampler site. The sulfur dioxide bubbler will be operated at the offices of the Tri-Borough Air Resources Management District. An analysis of existing ambient measurements of sulfur dioxide and of the emission inventory estimates of this pollutant both indicate that no current problems exist for this pollutant.

The procedures which will be used for locating samplers at these sites, for collecting and analyzing samples, and for data handling are in Section 5.0.

2.4 PROPOSED SURVEILLANCE SYSTEM

The Tri-Borough Air Resources Management District currently owns sampling equipment beyond that specified by the minimum requirements. In order to extend the geographical coverage of the region, and to utilize the available equipment, the high volume sampling network will be increased to continue sampling at some sites where a historical data base exists and to conduct special studies (Section 6.0).

The existing high volume samplers at the City Fire Station and the Muldoon Fire Station will continue to operate. To extend the geographical coverage of the region, high volume samplers will be operated at Talkeetna, Seward and Eagle River.

The measurement of dustfall provides an indication of the level of settleable particulates in a localized area. While not a highly precise measurement, it is relatively inexpensive and will provide data which can be evaluated on a year-to-year basis to show trends. This will be an effective check on any control strategies which are implemented to reduce blowing and/or traffic-entrained dust. Dustfall will be measured at each of the sites where high volume samplers are located, according to ISC Method No. 21101-01-70T*. A sampler elevation of 8-12 feet will be used.

---

*See Appendix

The proposed surveillance system for this region is listed in Table 2.7.

In order to establish background information on carbon monoxide and photochemical oxidants, short-term sampling programs will be conducted twice yearly. During February and August, one week sampling programs will be conducted to measure these gases. Samples will be taken in downtown Anchorage twice daily (morning and afternoon) on Monday through Friday. Manual sampling procedures will be used. For carbon monoxide, grab samples will be collected and analyzed by the manual colorimetric method, ISC No. 42101-02-69T.* For photochemical oxidants, 30 minute samples will be collected according to ISC method No. 44101-01-70T*, with appropriate consideration for sulfur dioxide and nitrogen dioxide. These manual techniques will provide an indication of the levels of these pollutants. If the levels exceed 50% of the respective ambient air quality standards, purchase of instrumentation for measurement by federally approved methods will be considered.

During these same two weeks, nitrogen dioxide will be measured using the 24-hour bubbler technique detailed in the April 30, 1971, Federal Register.

*See Appendix

TABLE 2.7

Cook Inlet Region: Proposed Air Monitoring System

Location	Hi Vol	Tape	Dustfall	SO_2 Bubbler
527 E. 4th (NASN)	XX	XX	X	
Tri-Borough Office (Tudor Road)	XX		X	XX
Trails' End Road	XX		X	
Kenai - Phillips	XX		X	
Palmer (Ag. Farm)	XX		X	
Muldoon Fire Station	X		X	
Talkeetna	X		X	
Seward	X		X	
Eagle River	X		X	
TOTAL	9	1	9	1

XX - Minimum Requirement

3.0 FAIRBANKS NORTH STAR BOROUGH

3.1 EXISTING PROGRAM AND AIR QUALITY DATA

A National Air Surveillance System high volume sampler and gas bubbler have operated at Third and Cushman Streets, with a sampler inlet elevation of three feet, since 1967. Gas bubbler sample results have been reported for sulfur dioxide by the West-Gaeke technique and nitrogen dioxide by the Jacobs-Hochheiser technique. Data are shown in Table 3.1.

During calendar year 1969, Fairbanks was a sampling station for the NASN Interstate Effects Surveillance Network, a static air pollution effects sampling program. Metal corrosion, fabric discoloration, silver tarnishing, sulfation, dustfall, nylon deterioration, rubber cracking and windblown particulates were evaluated. The effects package sampler was located on the roof of the four-story Post Office at Third and Cushman, at an elevation of approximately 60 feet.

The NASN high volume sampler and gas bubbler are the only samplers active in the Fairbanks North Star Borough at the present time. The Arctic Health Research Center has performed a number of studies which are no longer active. During the two-year period 08/25/67 to 6/11/69, an air quality study was performed at four sampling sites at Eielson Air Force Base, approximately 23 miles southeast of Fairbanks. Total suspended particulate, nitrogen dioxide, total nitrogen oxides, sulfur dioxide, aldehydes and ammonia were evaluated. Pertinent data are shown in Table 3.2.

During 1970 and 1971, in conjunction with an epidemiological study (submitted to the Archives of Environmental Health for publication), extensive data on carbon monoxide and nitrogen dioxide concentrations were obtained in the

TABLE 3.1

NASN Data: Fairbanks

Pollutant	Location	Sampling Interval (mo.)	Start Date	End Date	Number Samples	24-Hr. Max.	Arith. Mean	Geo. Mean	Geo. Std. Dev.
TSP $\mu g/m^3$	Fairbanks NASN 3rd & Cushman (3 feet)	12	01/67	12/67	23	767		124	2.84
		12	01/68	12/68	24	715		157	2.15
		12	01/69	12/69	24	867		175	2.21
		11	01/05/70	11/06/70	21	511			
SO_2 $\mu g/m^3$		12	01/67	12/67	41	107	9		1.97
		12	01/68	12/68	22	22	8		1.69
		12	01/69	12/69	25	28	9		1.54
NO_2 $\mu g/m^3$		12	01/67	12/67	39	224	75		1.76
		12	01/68	12/68	21	269	96		1.64
		12	01/69	12/69	23	233	68		2.04
		6	01/70	06/70	11		87		
Oxidant mg/m^3		12	01/68	12/68	21	30	13.9		
		12	01/69	12/69	9	18	12.0		
		6	01/70	06/70	4	17	11.5		

Table 3.2 ARCTIC HEALTH RESEARCH CENTER STUDY DATA: EIELSON AFB

Pollutant	Location (height)	Sampling Interval (mo.)	Start Date	End Date	Number Samples	24-Hr. Max.	Arith. Mean	Geo. Mean	Geo. Std. Dev.
TSP $\mu g/m^3$	Eielson AFB Guardhouse (5 ft)	22	08/25/67	06/11/69	23	178	67	56	2.06
SO_2 $\mu g/m^3$		22	08/25/67	06/11/69	26	4	0.18	--	----
NO_2 $\mu g/m^3$		22	08/25/67	06/11/69	25	78	19.3	13	2.93
TSP $\mu g/m^3$	Eielson AFB Warehouse (5 ft)	22	08/25/67	06/11/69	22	468	114	73	2.64
SO_2 $\mu g/m^3$		22	08/25/67	06/11/69	25	4	0.52	--	----
NO_2 $\mu g/m^3$		22	08/25/67	06/11/69	22	67	13.7	7.4	2.96
TSP $\mu g/m^3$	Eielson AFB Chapel (5 ft)	22	08/25/67	06/11/69	23	336	111	83	2.21
SO_2 $\mu g/m^3$		22	08/25/67	06/11/69	24	13	0.76	---	----
NO_2 $\mu g/m^3$		22	08/25/67	06/11/69	23	60	18.6	12	2.98
TSP $\mu g/m^3$	Eielson AFB Officers' Club (5 ft)	22	08/25/67	06/11/69	21	135	57	43	2.33
SO_2 $\mu g/m^3$		22	08/25/67	06/11/69	23	12	0.63	---	----
NO_2 $\mu g/m^3$		22	08/25/67	06/11/69	24	29	7.8	5.1	2.75

city of Fairbanks. Some samples for suspended particulate were obtained during this period, although the sampling schedule for particulate was not as complete as for the gaseous air pollutants.

Carbon monoxide was monitored using an MSA-Lira non-dispersive infrared carbon monoxide analyzer physically located in the basement of the Post Office at Third and Cushman Streets. The sampling inlet line extended out to the sidewalk and the inlet of the line was approximately 5 feet above sidewalk level. During the month of February, 1970, an average concentration of 11.8 mg/m^3 of CO was determined. This average of hourly data collected over an entire month is excessive since the NAAQS standard for eight hours is 10 mg/m^3. The maximum hourly value of 81 mg/m^3 was noted in the late afternoon.

To augment the data from this single point, air samples were collected in mylar bags at Nordale School, Barnette School and University Park School every morning, Monday through Friday, during the three-month period December, 1969, through February, 1970. For comparability of data, a bag sample was collected at the Post Office as well as at the three schools. The concentrations of carbon monoxide were evaluated using the continuous instrument. The concentrations are noted in Table 3.3.

The Arctic Health Research Center has conducted special sampling studies during periods of ice fog, a condition unique to arctic regions. The ice fog, which has a particle size range extending below 10 microns, forms when ambient temperatures are below about $-35^{o}F$. When high volume samplers were operated during ice fog conditions, the ice buildup on the filter reached a depth of over one inch. When the filters were returned to the laboratory the melting ice saturated the filter so that weighing could not be accomplished.

TABLE 3.3

AVERAGE WEEKLY VALUES, CO, ppm

WINTER 1969 - 1970

Date	Nordale School	Post Office	Barnette School	University Park School	Average* Wind, mph	Mean Temp °F
Dec. 69						
3-5	15	31	11	8	5.2	13
8-12	8	20	14	6	2.2	-7
15-19	8	25	9	6	4.2	6
22-24	9	19	8	5	9.6	2
Jan. 70						
5-9	5	15	5	4	5.4	13
12-16	6	11	7	8	5.3	-26
19-23	8	22	8	8	4.0	-9
26-30	5	10	5	4	3.9	-17
Feb. 70						
2-6	6	17	4	3	7.1	13
9-13	8	15	11	8	5.2	13
16-20	4	13	3	4	4.8	8
23-27	6	9	8	6	7.6	25

*U.S. Weather Bureau, Fairbanks International Airport

The Fairbanks North Star Borough operates as a local air pollution control agency in the State of Alaska. An Air Pollution Control Officer joined the staff in September, 1971. A local air quality surveillance program is in the preliminary stages of development at this time. The only complete air quality data for the borough for the year of 1971 are from the NASN sampler.

3.2 REGIONAL CLASSIFICATION

The Northern Alaska Intrastate Air Quality Control Region is classified as Priority I for suspended particulates on the basis of the National Air Surveillance Network Fairbanks data. It is classified as Priority I for carbon monoxide on the basis of the data collected in Fairbanks by the Arctic Health Research Center. On the basis of the NASN gas bubbler data and the Eielson Air Force Base study conducted by the Arctic Health Research Center the region is classified as Priority III for all other pollutants.

The Fairbanks North Star Borough encompasses all of the sampling sites where data for the regional classification were collected. On the basis of these classifications and the regional population, the minimum sampling requirements are:

For particulates, four high volume samplers, each collecting one 24-hour sample every sixth day, and one tape sampler collecting 2-hour samples continuously.

For sulfur dioxide, one bubbler collecting one 24-hour sample once every six days.

For carbon monoxide, one continuous analyzer.

All of these sampling instruments will operate within the Fairbanks North Star Borough.

3.3 MINIMUM REQUIREMENTS SURVEILLANCE SYSTEM

Major considerations in the design of this area's air quality surveillance system are the measured data which indicate where elevated concentrations have been noted, the population concentration in the City of Fairbanks, and the local geography.

Major point sources (>100 tons/year) for the entire Northern Alaska Intrastate AQCR are shown in Table 3.4. Further detail will be found in the Air Emissions Inventory for the State of Alaska, Appendix I, and in the Strategy section.

The area of estimated maximum concentration for particulates and CO is downtown Fairbanks. The NASN station will be one of the minimum requirements samplers for suspended particulates, and the bubbler will be the minimum requirement sampler for SO_2.

A second high volume sampler, and the tape sampler, will be operated at the offices of the Pollution Control Office in downtown Fairbanks. This will be the episode monitoring station for particulates. Based on the Anchorage data, the elevation of the high volume sampler can have an effect on the reported values. The NASN sampler in Fairbanks is located on a sidewalk between a busy street and a four-story building. This site will be extremely sensitive to reentrained street dust, if this is a contributing factor. To accomplish measurements which better indicate the true suspended particulate concentration in downtown Fairbanks, this high volume sampler will be located on a first or second story roof where it would not be unduly influenced by street dust.

TABLE 3.4

Major Emission Sources (>100 Tons/Year)

Region 009 - Northern Alaska Intrastate

Pollutant	Source No. (Inventory)	Source Name	Political Jurisdiction*	Current Emissions (T/yr)	Emissions (T/yr) (Uncontrolled)
Particulate	9	Eielson AFB	2	424	8,482
	10	Fairbanks Airport	2	190	190
	13	Fairbanks Municipal Util.	2	900	4,500
	14	Fairbanks Municipal Util.	2	160	880
	20	Ft. Wainwright	2	366	1,219
	21	Ft. Wainwright	2	178	1,487
	22	Ft. Wainwright	2	1670	13,700
	28	Golden Valley Elect.	2*	957	6,377
	47	Univ. of Alaska	2	195	3,250
SO_2	9	Eielson AFB	2	570	570
	13	Fairbanks Municipal Util.	2	235	235
	22	Ft. Wainwright	2	650	650
	28	Golden Valley Elect.	2*	392	392
	47	Univ. of Alaska	2	190	190
CO	8	Eielson AFB	2	852	852
	9	Eielson AFB	2	750	150
	10	Fairbanks Airport	2	709	709
	19	Ft. Greely	2*	191	191
	22	Ft. Wainwright	2	168	168
	28	Golden Valley Elect.	2*	103	103
	38	NASA Station	2	106	106

2 Fairbanks North Star Borough

2* Northern Alaska AQCR but not in Fairbanks North Star Borough

The third high volume sampler will be located at University Park School, representative of a residential area in Fairbanks.

The fourth high volume sampler will be a background monitor, operated at a convenient location on Birch Hill. Observations during ice fog conditions indicate that Birch Hill is above the winter inversions.

The continuous CO monitor will be operated at the Pollution Control Office in downtown Fairbanks. This instrument must have a full scale range of 100 ppm in order to measure the anticipated range of concentrations.

The operation of the high volume samplers and tape sampler during ice fog conditions, based on the Arctic Health Research Center experience, will require some modification of the standard instruments in order to collect useful data. One technique which promises success is the warming of the air to the point where the ice fog particles will sublime. The first technique which will be evaluated is the installation of radiant heat lamps in the roof of the high volume sampler shelter. For the tape sampler, a section of metal tubing wrapped with heating coils will be used. Technical assistance from EPA will be sought to verify this modification, and for alternate suggestions if this proves unsatisfactory.

In order to predict air stagnations, which are the major factor leading to air pollution emergency episodes, it is critically important that accurate predictive meteorological forecasts be received in a timely fashion. Because the Fairbanks geography is such

that episodes could occur over a small area, a local climatologist must issue these forecasts. The National Weather Service office at the Fairbanks International Airport is the best possibility for this coordination.

3.4 PROPOSED SURVEILLANCE SYSTEM

The minimum requirements surveillance system does not provide adequate geographical coverage of the City of Fairbanks or the remainder of the borough.

Additional high volume samplers will be located at the Nordale School, at a site in the Aurora subdivision, at a site in the South Fairbanks subdivision, at the Fairbanks International Airport, at a site in the community of North Pole, and, if possible, at a presently unidentified site on the flat plain about 15 miles south of Fairbanks. The last site will provide data on the suspended particulate concentration in an uninhabited and unpopulated portion of the borough. This will be valuable in confirming whether or not the Birch Hill site represents an appropriate background location. To augment the carbon monoxide data acquired by the continuous monitor, grab samples will be collected at the downtown station, University Park School, Nordale School, the Aurora subdivision station and the South Fairbanks subdivision station on an intermittent basis. These samples will be collected in mylar bags using a small diaphragm pump with an inlet line filter and a needle valve to control the flow rate so that the bags fill at a constant rate over a period of one hour. Analyses will be performed at the continuous instrument. The purpose of the sample at the downtown location is to verify that the sampling technique is valid, i.e., that

there is no decay of CO from the time the samples are collected to the time they are analyzed. Once this is verified, the apparatus used to collect the downtown sample will be free for use at other locations which may be of interest. The background site at Birch Hill is one location which should be checked during a winter inversion; other samples will be taken to determine the geographical extent of elevated CO values.

These grab samples for CO will be collected during air stagnation periods as a basic investigation to provide engineering data valuable in evaluating the control strategy for CO. While some samples may be taken for special studies during good atmospheric ventilation periods to check out the equipment and obtain baseline data, the primary use of the technique will be during air stagnation periods. Samples will be collected on an infrequent and intermittent basis; perhaps only once or twice daily for a period of one or two weeks if the results show a consistent pattern of CO distribution. The NASN bubbler will continue to obtain data on NO_2.

The reported NASN data for suspended particulates suggest that there is a significant particulate problem in Fairbanks. The annual geometric mean of 175 $\mu g/m^3$ is more than double the primary air quality standard of 75 $\mu g/m^3$. As discussed in Section 3.3, Minimum Requirements, this data may only be representative of a localized dusty street problem rather than a significant general problem. Some of the special studies described in Section 6.0 are intended to resolve this matter.

To provide baseline information on dust levels in the borough, dust fall samples will be collected at the downtown site, University Park School, Nordale School, Birch Hill and the site about 15 miles south of Fairbanks. Dustfall equipment is inexpensive and the data will be useful to evaluate trends on a year-by-year basis. The information gained will provide one measure of the effectiveness of particulate control strategies.

The proposed air quality surveillance system is shown in Table 3.5.

TABLE 3.5

FAIRBANKS NORTH STAR BOROUGHS: PROPOSED AIR QUALITY SURVEILLANCE

Location	Hi Vol	Tape	Dustfall	SO_2 Bubbler	NO_2 Bubbler	Continuous CO	Grab CO
3rd & Cushman (NASN)	XX			XX	X		
Downtown	XX	XX	X			XX	X
University Park School	XX		X				X
Nordale School	X		X				X
Aurora Subdivision	X						X
S. Fairbanks Subdivision	X						X
Airport	X						
Birch Hill	XX		X				
North Pole	X						
About 15 miles South	X		X				
TOTAL	10	1	5	1	1	1	5

XX = Minimum Requirement

XX = Episode monitoring station

4.0 BALANCE OF STATE

The two local programs will operate and maintain the air quality surveillance programs in their respective areas. The state program will be responsible for monitoring the air quality over the balance of the state, performing special studies throughout the state, and providing technical assistance as required to the local program. Although the population is low and there is relatively little industrial activity at the present time, the State of Alaska has a significant potential for growth, both in population and industrial activity. To adequately protect the air resources of the state, an orderly plan for the acquisition of air quality data with limited resources has been developed and is outlined below.

The state program is solely responsible for the balance of the Northern Alaska AQCR (that portion outside of the Fairbanks North Star Borough) and the entire South Central and Southeastern AQCR's. The initial step in the planned activity will be to meet the minimum federal requirements in these Air Quality Control Regions. Once these requirements are met, or scheduled to be met in compliance with the prescribed schedule, major attention will be devoted to special studies.

4.1 EXISTING PROGRAM AND AIR QUALITY DATA

The air pollution program of the State of Alaska became viable in mid-1971 when the first full-time professional staff member was retained to work full time on air pollution. With the additional capability of federally funded state assignees in 1972, the program is in a position to initiate air quality surveillance activities.

No air quality data have been collected for the State of Alaska beyond that already reported for the Anchorage and Fairbanks areas.

4.2 REGIONAL CLASSIFICATION

The Northern Alaska Intrastate Air Quality Control Region #009, as discussed above, is classified as priority I for particulate matter and carbon monoxide, and priority III for all other pollutants.

The South Central Intrastate Air Quality Control Region #010 is nearly devoid of air pollution sources. The emission inventory for major point sources (>100 tons/year) is shown in Table 4.1. This region is classified as priority III for all pollutants.

The Southeastern Alaska Intrastate Air Quality Control Region #011 has the most temperate climate in the state. Forest product industries are the principal activity, as shown in Table 4.2, the emission inventory for major point sources. Based on calculations of the maximum ground level concentration of sulfur dioxide from the largest point source in the region, a priority I classification is determined. Since this is a single source, the region is classified as priority IA for sulfur dioxide. The classification for all other pollutants is priority III.

Based on these classifications, the minimum requirements which must be met are:

<u>Region 009</u>

(See Section 3.2)

TABLE 4.1

Major Emission Sources (>100 Tons/Year)

Region 010 - South Central Alaska Intrastate

Pollutant	Source No. (Inventory)	Source Name	Political Jurisdiction*	Current Emissions** (T/yr)
Particulate	24	Naval Sta. - Kodiak	5	200
SO_2	6	Cape Romanzoff	2	151
	22	Naval Sta. - Kodiak	5	180
CO	11	King Salmon Airport	3	350
	15	Kodiak Electric	5	384
	19	Naval Comm. Sta. - Adak	1	153
	20	Naval Comm. Sta. - Adak	1	680
	24	Naval Sta. - Kodiak	5	1,058
	28	Shemya AFB	1	488
	30	Shemya AFB	1	122

1 Aleutian Islands

2 Bethel - Kiskokwin

3 Bristol

5 Kodiak Island

** All sources are currently uncontrolled.

TABLE 4.2

Major Emission Sources (>100 Tons/Year)

Region 011 - Southeastern Alaska Intrastate

Pollutant	Source No. (Inventory)	Source Name	Political Jurisdiction*	Current Emissions** (T/yr)
Particulate	7	Alaska Wood Products	6	744
	8	Alaska Wood Products	6	107
	10	Belardi & Schneider	3	1270
	22	Wrangell Lumber	6	395
	23	Wrangell Lumber	6	143
	25	Alaska Lumber & Pulp	5	1000
	26	Ketchikan Pulp	2	2000
SO_2	25	Alaska Lumber & Pulp	5	1600
	26	Ketchikan Pulp	2	3400
CO	1	Alaska Elect. Light	3	160
	4	Alaska Prince Timber	6	107
	6	Alaska Prince Timber	6	156
	8	Alaska Wood Products	6	1988
	9	Annette Airport	6	159
	10	Belardi & Schneider	3	3750
	11	Juneau Airport	3	243
	12	Ketchikan City P.U.	2	158
	14	Mitkoff Lumber	6	325
	21	Wrangell City	6	106
	22	Wrangell Lumber	6	7342
	23	Wrangell Lumber	6	2649

2. Ketchikan

3. Juneau - Douglas

5. Sitka

6. Wrangell-Petersburg

** All emission sources are currently uncontrolled.

Region 010; South Central Intrastate AQCR

For particulates, one high volume sampler collecting one 24-hour sample every sixth day.

For sulfur dioxide, one bubbler collecting one 24-hour sample every sixth day.

Region 011; Southeastern Intrastate AQCR

For particulates, one high volume sampler collecting one 24-hour sample once every sixth day.

For sulfur dioxide, three bubblers each collecting one 24-hour sample every sixth day; and one continuous analyzer.

4.3 MINIMUM REQUIREMENTS SURVEILLANCE SYSTEM

The minimum requirements for the Northern Alaska Intrastate AQCR are met by the surveillance system in the Fairbanks North Star Borough.

The South Central AQCR is rich in mineral resources which are presently untapped due to the expense of developing the known reserves. The single industrial project which is now in the advanced planning stage, and which could have a major impact on air quality, is the development of a deep water shipping facility at Valdez, the proposed terminus of the Alyeska pipeline. The air quality surveillance system for this region will be preventative in that it will provide baseline information against which future air quality can be compared. The minimum sampling requirements will be met by the installation of a high volume sampler and sulfur dioxide bubbler in Valdez.

In the Southeastern Alaska AQCR the high volume sampler, two bubblers and the continuous sulfur dioxide analyzer will operate in the immediate vicinity of the pulp mill at Ketchikan. The bubblers will be sited at other locations in the vicinity, to verify that the area of maximum ground level concentrations is being monitored by the continuous instrument. The third sulfur dioxide bubbler for this AQCR will be located in the immediate vicinity of the pulp mill at Sitka at the area of estimated maximum ground level concentration.

4.4 PROPOSED SURVEILLANCE SYSTEM

Extensions beyond the minimum systems will be heavily dependent on available manpower and resources. Attention to special studies may preclude additional routine surveillance activities until 1973 or later.

In order to protect the air resources of the State of Alaska from degradation through industrial development, the Permit System will be the primary mechanism to assure that emissions of air pollutants are planned at levels which will not be undesirable. To augment this procedure, the developers of major projects will be required to conduct a pre-operational air quality study, and a similar post-operational study, to verify that their operations are not causing an undue increase in the air pollutant burden. At a minimum, these studies will include measurement of suspended particulate matter at a minimum of two sampling sites. If any other air pollutants, e.g., sulfur dioxide

in the case of non-ferrous smelting operations, are anticipated, tests for the appropriate pollutants will be included. The relationship between climatological factors and measured suspended particulate concentrations in Anchorage and Fairbanks indicates that climatological factors should be recorded at the time each sample is collected. The details of test programs of this type, including a detailed schedule of sampling and analytical procedures, will be prepared by each industry concerned. Since this plan must be approved by the State of Alaska, it is expedient that the industry work in cooperation with the state during the formulation of the test program.

In the Southeastern Alaska AQCR, two additions to the minimum surveillance system are planned. A high volume sampler will be operated in conjunction with the sulfur dioxide bubbler at Sitka. In the vicinity of Wrangell there are several large teepee burners. A high volume sampler will be operated near one of the large teepee burners, for a period of at least one year, to establish the particulate air quality.

5.0 SAMPLE COLLECTION AND DATA HANDLING

5.1 SAMPLE COLLECTION AND ANALYSIS

The procedure for placement of samplers, the mechanism of collecting samples, and the techniques for analysis will be consistent throughout the State of Alaska.

EPA Publication No. AP-98, "Guidelines: Air Quality Surveillance Networks," presents specific information pertaining to the operation of surveillance networks. The four points of concern for sampling site characteristics, for example, are:

1. Uniformity in height above ground level is desirable for the entire network within the region. Some exceptions may include canyons, high-rise apartments, and sites for special purpose samplers.
2. Constraints to air flow from any direction should be avoided by placing inlet probes at least three meters from buildings or other obstructions. Inlet probes should be placed to avoid influence of convection currents.
3. The surrounding area should be free from stacks, chimneys or other local emission points.
4. An elevation of three to six meters is suggested as the most suitable for representative sampling, especially in residential areas. Placement above three meters prevents most reentrainment of particulates as well as the direct influence of automobile exhaust.

The fourth point, pertaining to the elevation of samplers, is particularly important for placement of high volume samplers in Alaska because of the apparent effect of reentrained road dust.

High volume samplers and sulfur dioxide bubblers will operate every sixth day. The state will issue a sampling schedule in November for the following year. All 24-hour samples will be collected midnight-to-midnight, local time.

The operating procedure for high volume samplers is detailed in the April 30, 1971, Federal Register. This document includes procedures for instrument calibration procedures to correct for extreme atmospheric conditions.

Bubblers for sulfur dioxide rely on a very small orifice for air flow regulation. This orifice is subject to clogging, so a flow check will be made just prior to collecting each sample, and just after the sampling period is completed. If the latter reading indicates that the air flow is reduced, that sample will be discarded.

In many cases, it will be possible to locate bubblers inside buildings, using glass or teflon^{R} tubing to bring the air sample to the bubbler. Where the bubbler must be used outside in the winter, special arrangements must be made to prevent freezing. The Arctic Health Research Center has developed a satisfactory procedure. The bubbler box is placed inside a foot locker which is insulated and heated. This adequately protects the bubbler and the pump from rain, snow and extreme cold.

The sampling and analytical procedures for sulfur dioxide (and nitrogen dioxide) bubbler samples are detailed in the April 30, 1971, Federal Register.

The continuous sulfur dioxide analyzer will operate near Ketchikan. Specifications are detailed in paragraph 420.17 of the August 14, 1971, Federal Register. The pulp mill which is the point source in the area is a sulfite process mill, so the sulfur emissions are essentially all sulfur dioxide. For

operational reliability, a dry state flame photometric sulfur dioxide analyzer will be used rather than an analyzer based on automated wet chemistry. The basic flame photometric detector is a total sulfur analyzer.

If a kraft process pulp plant is initiated in the state, the flame photometric analyzer will report reduced sulfur compounds as SO_2. Odor complaints are generally based on the mercaptans and other reduced sulfur compounds rather than sulfur dioxide; to upgrade the flame photometric detector to measure these components individually a teflon^R gas chromatographic column can be used ahead of the detector. This procedure was developed by EPA. It adds to the cost and complexity of the instrument, but will be considered as a useful extension of the air quality surveillance system should a kraft process pulp plant initiate operation in the State of Alaska.

Calibration of the continuous sulfur dioxide analyzer can be accomplished by three methods. The bubbler samples which will be collected at the site are a basic calibration technique. Alternately, a prepared mixture of sulfur dioxide in air can be generated and measured concurrently by the instrument and a midget impinger. Permeation tubes are commonly used to generate the sulfur dioxide-in-air mixture. The third technique uses calibrated permeation tubes at a controlled temperature to generate a known concentration of sulfur dioxide. The latter technique is not easily adapted to field use, but is preferred where laboratory conditions can be duplicated.

The continuous analyzer for carbon monoxide will meet the specifications of paragraph 420.17 of the

August 14, 1971, Federal Register, with the single exception being a full scale range of 100 ppm rather than 50 ppm. Calibration of this instrument simply involves routine checks using a "zero CO" gas and a span gas, containing 60-80 ppm of CO. Adjustments to the instrument are made as required to maintain calibration.

In those portions of the state where local assistance will be required to maintain and operate sampling equipment, the operator will be instructed in writing and in person by state personnel concerning the procedures for sample collection and handling. Samples will be sent to the state laboratory in Juneau for analysis, and supplies will be sent from this laboratory to such locations. EPA has developed detailed procedures for handling high volume sampler filters and the liquid reagents from gas bubblers. There will be no loss in accuracy for the gas bubblers if the fresh reagent and/or the samples are frozen in transit.

5.2 DATA HANDLING

Requirements for reporting of data are detailed in Paragraph 420.7 of the August 14, 1971, Federal Register:

> (a) On a quarterly basis commencing with the end of the first full quarter after approval of a plan, or any portion thereof, by the Administrator, the State shall submit to the Administrator (through the appropriate regional office) information on air quality. The quarters of the year are January 1 through March 31, April 1 through June 30, July 1 through September 30, and October 1 through December 31.

(b) The reports required by this section shall be submitted within 45 days after the end of each reporting period in a manner which shall be prescribed by the Administrator.

The precise format for submission of data has not been defined by EPA at this time. Until such time as it is defined, the format from Appendix H of the August 14, 1971, Federal Register, will be used. This requires that, for each pollutant reported, specific information be provided on sample site location, number of months in the sampling interval, start date, end date, and number of samples be reported. For high volume samples the maximum 24-hour value, geometric mean and geometric standard deviation are to be reported. For sulfur dioxide, from either bubblers or continuous instruments, the maximum 24-hour value, annual arithmetic mean and geometric standard deviation are to be reported. The report for carbon monoxide is to include the maximum one-hour and maximum eight-hour value, with the geometric standard deviation. For carbon monoxide, the geometric standard deviation will be based on one-hour values unless the new reporting requirements specify a different value.

The SAROAD format, developed by EPA, will be used for numerical identification of sample site location, pollutant, measurement technique and analytical technique.

Manual reduction of data from recorder strip charts is a time-consuming and inefficient task. Lower overall costs and increased accuracy are available through the use of electronic data processing techniques. The two continuous analyzers will have a strip chart

recorder and a system to record the instrument output on magnetic tape cassettes. These cassettes, available from Westinghouse and other manufacturers, can be returned to the supplier for data reduction and statistical treatment on a contract basis, or processed on special equipment designed for that purpose.

The reporting format calls for the calculation of the geometric standard deviation of all pollutants. This will present no problems with suspended particulate matter. The method has a lower limit of range of one microgram per cubic meter, which will result in non-zero measurements for all 24-hour samples.

When values are determined which are below the range of a method, or when there is none of the measured pollutant in the air stream, zero readings can result. Since it is not possible to compute logarithmic parameters of zero, alternate techniques must be used.

One technique which has been used successfully to determine the geometric standard deviation of air pollution measurements is possible because most measurements follow a log-normal distribution. When the frequency distribution is plotted on logarithmic probability graph paper, a straight line results. The geometric standard deviation is determined by dividing the 84.13 percentile value by the 50.00 percentile value. This method can be used when a body of data contains zero readings by plotting the frequency distribution curve, estimating by eye the best fit straight line for the high concentration end of the curve, and extending this straight line through the percentile values noted above.

In order to use direct computation techniques, either by desk calculator or by computer, a "near-zero" dummy value must be substituted for the zero readings. Values which will be used are 0.2 ppm for carbon monoxide and 1.0 $\mu g/m^3$ for sulfur dioxide.

5.3 DATA ANALYSIS

The objective of the Air Surveillance System is to produce data to allow long term trends and short-term excursions in air pollutant levels to be identified. Analysis of this data provides the information on which episode condition identification and resulting actions are based. Analysis can also identify trends to assist in future agency planning and control action.

Proper interpretation of the air quality measurements will depend upon the collection and evaluation of additional data. Meteorological parameters significantly influence ambient air quality and two specific types of data collection activities are recommended to complement the air quality surveillance activities. First, the station operator should observe and record, at the time of sample collection, the temperature, wind speed and direction, cloud cover, surface moisture and any other factor which can be easily observed and might assist in data interpretation. Second, the Local Climatological Data summaries prepared by the Environmental Science Services Administration should be obtained on a monthly basis. These two data sources will permit a meaningful analysis of ambient air quality measurements in terms of local meteorological conditions. Data concerning emission sources must also be considered in the analysis and this data will continuously be updated through the use of an ongoing permit and registration system.

The statistical treatment of the data depends on the specific objective of the analysis. Arithmetic means, median values and their distribution statistics summarized in the reporting formats identified in Section 5.2 can be used to identify long term trends and cycles. The success of the control program will be judged against these trends and decisions on the degree of future control may also be based on trend measurements.

A more rigorous statistical approach is required to identify and quantify short-term air quality excursions. The time parameters for measurements are particularly important for these conditions. For example, continuous measurements (suitably damped by an appropriate moving average or digital filtering techniques) are needed to study relationships between contaminant levels and a controlling feature such as atmospheric temperature inversion conditions. Because not all the monitoring is continuous, a frequency distribution approximation based upon probability techniques would be required to estimate time variables at intermittent sites. Various statistical techniques (variance analysis, regression analysis, etc.) are used to insure significance between predicted and measured values during data analysis. This is particularly important during episode conditions to ensure that the decisions concerning control actions are adequate to meet emission reduction requirements without unduly curtailing the general activity of the affected region.

The two major analyses to be performed using the data for short-term excursions are the relationship between pollutant levels and meteorological factors and between emission sources and air quality. These relationships must be analyzed together to determine the degree to which air quality is affected by known sources,

both during episode curtailment decisions and for long-term control. In special circumstances, these techniques can be used to identify unknown sources through the collection, measurement and analysis of particular air contaminants.

6.0 SPECIAL STUDIES

The determination of cause and effect relationships between sources of air pollution and ambient concentrations is an essential step in the development of air pollution control strategies. The acquisition of air quality data under controlled conditions can contribute to this knowledge. While the term "air surveillance network" normally refers to the operation of sampling instruments at a fixed site over an extended period of time, "special studies" refers to a short-term study with a specific objective.

6.1 TRAFFIC GENERATED SUSPENDED PARTICULATE MATTER

The measured elevated suspended particulate levels in Anchorage and Fairbanks are not solely caused by point sources of emission, as discussed in the Strategy section. Based on the climatological analysis, the elevated levels are definitely associated with warm, dry days. There are numerous hypotheses which may explain this phenomenon, among them dust from unpaved roads, an elevated "background" level from winds over exposed glacial silt, dust on the streets resulting from the sand, etc., used on the icy streets during the winter, and the general dustiness of the street.

Table 6.1 describes a methodology to be used for the evaluation of the degree of entrainment of dust from streets. This study procedure will be used at a street or road location upwind of the central business and commercial district in the city where the test is conducted. The results will show the effect of traffic on suspended particulate concentrations upwind and downwind of the road. This methodology will be used to evaluate

specific road treatment techniques such as water washing, vacuum cleaning, and any other techniques which might prevent the reentrainment of particulate matter.

The basic study matter described in Table 6.1 can be further utilized if the preliminary results show a definite correlation between traffic, road conditions, and suspended particulate concentration. Additional high volume samplers may be placed farther downwind, and at varying elevations, to determine the extent of the travel of traffic-generated particulate matter.

The suspended particulate data obtained from this study will be used to quantify the contribution of traffic generated dust. It may not be possible to develop an emission factor relating a certain level of traffic on a specific type of surface to tons of particulate matter generated. The up and down wind measurements will, however, give a relative measure for different types of roadways and for different control measures. For example, suppose a certain traffic level produces a difference between up and downwind samples of 30 $\mu g/m^3$ on a paved road and street sweeping reduces this difference to 15 $\mu g/m^3$. If oiling of soft shoulders on the same roadway reduces the concentration difference only to 25 , it can be concluded that the street sweeping program is more effective than oiling road shoulders and will produce a larger, although unknown, decrement in ambient air concentrations.

The special study deailing with traffic generated dust will be instituted during June and July of 1972. This will allow initial study results to assist in the determination of the specific control measures to be

used in the initial year's control strategy. Continuation of the study through the remainder of 1972 and the first half of 1973 will provide the data base necessary for planning the 1973-1974 control program. This study will be initiated in the Greater Anchorage Area due to the availability of sampling equipment and trained technicians at this location. A series of tests will be scheduled later in the study for the Fairbanks North Star Borough.

TABLE 6.1

DUST GENERATED BY MOTOR VEHICLES: SPECIAL STUDY

Purpose:

To measure the effect of automotive traffic on total suspended particulates.

Equipment and Manpower Requirements:

2 Hi Vols

1 Anemometer - portable

1 Technician/day

Procedure:

1. There should be a very light cross wind to minimize natural dust entrainment.
2. Place two hi vols on opposite sides of the road in the following arrangement:
   a. Place one hi vol 30 feet from the curb in the upwind direction and five feet above street level.
   b. Place the second hi vol four feet from the opposite curb in the downwind direction and five feet from the street level.
3. Place the anemometer near the first hi vol.
4. Sample for four hours. Record the average wind speed and direction and the total traffic volume and estimated average car speed.

5. The experiment will be conducted by sampling under some or all of the following conditions:

   a. Baseline Measurements - These tests will define particulate matter generation under current conditions.

      Uncontrolled Traffic Flow

      (1) Paved road - slow traffic
      (2) Unpaved road - fast traffic
      (3) Unpaved road - slow traffic
      (4) Any or all of the above on a wet day
      (5) Any or all of the above on a windy day (5-12 mph)

      Controlled Traffic Flow

      (1) Five cars at 30 mph. Two car lengths apart in a continuous loop.
      (2) Five cars at 50 mph - Four car lengths apart.
      (3) Two cars at 30 mph - One minute apart.

   b. Road Surface Treatments - Repeat any of the above with the following added conditions to test the effectiveness of the proposed control measures.

      (1) Immediately after street sweeping on a paved road.
      (2) Twenty-four hours and forty-eight hours following street sweeping under generally the same climatic conditions.
      (3) Immediately, 7 days and 21 days following the application of oil to a gravel road. Again roughly similar climatic conditions must be selected for sampling.

6.2 PARTICULATE MATTER DISTRIBUTION BY HEIGHT

The suspended particulate measurements at the City Fire Station and the NASN site in Anchorage suggest the elevation of the high volume sampler may affect the results. This difference can be determined by operating two high volume samplers at the same site but at different elevations. Table 6.2 describes a special study which can be conducted to provide a substantive basis for selection of a desirable sampling elevation. The particle size distribution of the suspended particulate matter in Alaska has not been determined. The federal criteria for suspended particulate matter are based on the usual particle size distribution measured by the National Air Surveillance Network, mainly in urban areas of the lower 48 states. EPA data (presently being prepared for publication) using the Andersen sampling attachment on a high volume sampler indicates that the mass mean diameter of suspended particulate matter in both center city locations, urban locations, e.g., Steubenville, Ohio, and Seattle, Washington; and non-urban locations, e.g., Grand Canyon National Park, varies from about 0.5 to 1.0 microns. If reentrained road dust is a major factor affecting the Hi Vol sampling results in Alaska, the mass mean diameter of the suspended particulate matter will decrease as elevation increases. Three basic considerations will be used in evaluating the results of this study.

1. EPA guidelines for sampler placement specify desirable sampling elevations of between 3 to 6 meters above the ground.
2. This study will define the sampler elevation at which a representative sample of airborne particulates can be obtained.
3. The criteria to be used in determining this elevation will be mass median diameter.

EPA is leading the technology in this type of measurement, so close coordination with EPA will be maintained when these studies are conducted.

The samples which will be routinely collected to determine dustfall may be sensitive to sampler elevation. The study described in Table 6.3 will quantify these differences at various urban and non-urban sampling sites. On the basis of these results, a single elevation considered to be most representative will be selected for sampling in the State of Alaska.

TABLE 6.2

RELATIONSHIP OF HIGH VOLUME SAMPLER ELEVATION AND PARTICULATE SIZE DISTRIBUTION: SPECIAL STUDIES

Purpose:

To evaluate the particle size distribution of suspended particulate matter as a function sampler elevation.

Equipment Requirements and Manpower:

2 Hi Vol samplers with Andersen Sampling Head

1 Technician, 6 hours per test

Procedure:

1. Place one sampler at an elevation of 4 feet above ground in a downtown location next to a one-story building where the street is paved and there are sidewalks and curbs.
2. Place second sampler on the roof of the building above the first sampler.
3. Sample for 24 hours.

4. Analyze the samples and calculate the particulate size distribution.
5. Repeat the tests six times.
6. This experiment can be repeated at:
   a. Different elevations
   b. Different sampling locations where streets are not paved or were paved but were more or less dusty than at the original location.
   c. Different location with very light traffic.

TABLE 6.3

DUSTFALL: SPECIAL STUDY

Purpose:

To measure the variation in dustfall with sampling elevation.

Equipment and Manpower Requirements:

4 dustfall jars

1 technician - 1 man-day

Procedure:

1. Prepare four dustfall jars.
2. Arrange the four jars on a utility pole or other usable pole at least 20 feet high. Place the jars five feet apart vertically beginning at five feet above the ground.
3. Sample for one month and analyze the particulate concentration in each of the four jars. Note any variation in particle size or type in the four jars.
4. This experiment can be repeated under varying meteorological conditions and at various urban and non-urban sites.

6.3 A SPECIAL STUDY FOR THE IDENTIFICATION OF SUSPENDED PARTICULATE MATTER

The objective of this study will be to identify the sources of suspended particulate matter under varying conditions in the Fairbanks North Star Borough. The desirability of the study was indicated by the results of the atmospheric diffusion estimates made during the selection of control strategies. These results indicated that a high proportion of the suspended particulate matter during the winter season could be accounted for from the emissions of coal fired boilers in the Fairbanks area. If this result can be verified, the application of efficient particulate collection devices on a relatively few sources could achieve National Ambient Air Quality Standards during the winter months in Fairbanks. The basic objective of this study done will be to determine the fraction of suspended particulate matter which can be attributed to coal combustion.

Methods and Equipment - There are several possible methods for obtaining the desired information. It is not possible at this time to predict which method or combination of methods will most adequately describe the situation in the Fairbanks area. Three potential methods are presented below, together with a description of how they may be implemented and evaluated with regard to the objectives of the study.

First, morphological particle identification. This method, using a light microscope, represents the easiest and potentially the most applicable method available for this study and should be evaluated first. The procedure consists of preparing a suitable microscope specimen which is then visually examined or photographed and the particle size and shape are correlated with the

potential source of the particulates. The initial step in this investigation will be to obtain a sample of the fly-ash from one or more of the large coal burning installations in the area. Another sample of road dust and/or soil from the area will be microscopically examined at the same time. If the visible characteristics of the two types of particulate matter appear to be sufficiently distinct then the microscopic evaluation technique can be applied to ambient air quality samples. A refinement of this procedure using an electron scanning microscope can be considered if the ambient samples show a large portion of the particulate matter to be in the submicron particle size range. An applicable reference to this procedure is the work of Walter C. McCrone.[1]

Chemical Composition Analysis - The second method for approaching the problem of separately identifying the various sources of suspended particulate matter is the detailed chemical analysis of the various particulates. This would be a qualitative and quantitative description of the elemental composition of fly-ash and road dust or soil samples. The key element in such an analysis would be the presence of a chemical element in the fly-ash sample which was not normally found in the dust or soil samples in the vicinity. This key element could then be analyzed for in the ambient air samples and would provide an indication of the degree to which fly-ash was contributing to the mass of the collected material. The chemical analysis would probably be done by mass spectrographic techniques and the Fairbanks North Star Borough or the State should probably consider retaining the services of a consulting chemical laboratory for this study if the chemical analysis method is chosen.

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[1] Walter C. McCrone in: Air Pollution, Vol. 2, edited by Arthur C. Stern, Academic Press, New York, 1968, Page 301

Tracer Study - The third approach that may be considered in the analysis of this problem would be the use of artificial tracers to measure the distribution of pollutants from particular sources. In this case a tracer material would be introduced into the exhaust gas stream of several of the major coal burning facilities in the area. This sampling network would be set up in the area of interest and the samples would be analyzed for the tracer material. This would provide an indication of the absolute amount of air pollutant contributed to ambient concentrations by the group of coal burning sources. Tracer materials which can be considered for such a study include zinc cadmium sulfide, a phosphorescent light. Second tracer material in wide use is sodium hexafluoride. This gas has a very high sensitivity of detection by gas chromatographic methods. The use of a tracer study to define this problem, while adequate results could probably be obtained, is not recommended since a good deal of expense both in terms of equipment and technically trained manpower would be required to initiate and carry out such an investigation. It should be hoped that the first method, morphological microscope analysis, would provide at least a rough indication of the relative importance of the various sources in the Fairbanks area.

Scheduling - Initial work on this study should begin during this summer of 1972 so that the background data and methodology can be finalized prior to the winter of 1972/73. In the study phase, simultaneous ambient measurements at at least two locations should be made with three replicata tests taken under essentially similar climatological conditions. The field sampling phase will thus consist of taking samples at two locations

for 24 hours. This sampling will be repeated on 10 to 15 days in the course of a six-month period. This schedule will allow a full appreciation of the impact of stationary coal fired combustion units on the ambient particulate matter levels in the Fairbanks area by mid-summer 1973.

Data Interpretation and Evaluation - The details of the data collected under the special study will, of course, depend upon the precise method used. In any case, however, the basic and decision making aspect of the study will be the percentage contribution to the ambient suspended particulate matter concentrations of the coal fired boilers. These data will allow a reconsideration of the desirability and effectiveness of installing highly efficient particulate collection devices on these sources. If this study indicates that only a relatively small reduction in ambient concentrations could be expected from the installation of such devices then the recommendations as presented in the Control Strategy Volume would have to be modified. On the other hand, if the results substantiate the air quality calculations made then the control agency will be in a sounder position in recommending and requiring the installation of efficient particulate collection equipment.

6.4 REMOTE AREA SAMPLING

The problems of transportation and severe climate suggest that the most economical procedure for determining air quality in remote areas would be the performance of short-term intensive studies at as many locations as possible when conditions permit travel. Since particulates are the major problem in most areas of Alaska, some form of particulate sampling would be a primary requirement

for a remote area sampling unit. Total suspended particulate data from Anchorage and Fairbanks indicate a very strong correlation between meteorological conditions and particulate concentrations; therefore, any remote sampling must include the acquisition of climatological data. In order for the data to be representative of air quality on an annual basis, there would have to be some basis for extrapolating from the short-term data base to a longer time period.

It is concluded that it is impractical to monitor suspended particulates in remote areas through short-term studies. If a location, e.g., Kodiak or Kotzebue, is considered for the determination of suspended particulate levels, then local assistance will be arranged so that the normal sampling schedule can be followed.

It may be desirable to conduct sampling programs for hazardous materials or gases in remote areas. In these cases, should they arise, special arrangements will be made to fit the needs of the specific situation.

6.5 HAZARDOUS MATERIALS

The mineral wealth of Alaska includes such potentially hazardous materials as beryllium and mercury. Most of the potentially hazardous air pollutants are in the form of particulate matter at ambient conditions. When processing plants for potentially hazardous materials are constructed, there will be at least two high volume samplers in operation on an every-sixth-day schedule for a period of at least one year. Specific analytical procedures, and technical assistance if required, will be sought from EPA to assure that the analyses are meaningful.

6.6 GASEOUS POLLUTANTS

At the present time EPA has defined ambient air quality criteria for sulfur dioxide, carbon monoxide, photochemical oxidants and nitrogen dioxide. Hydrocarbons are considered only as a precursor to photochemical oxidants. In the near future, it is anticipated that federal ambient air quality standards will be issued for more gases, including (at least) fluorides and odorous compounds.

As each of the new criteria is developed, the potential sources of emission in the State of Alaska will be evaluated with respect to the specific air pollutant. As appropriate, special studies of these gaseous pollutants will be conducted.

7.0 TIMETABLE FOR COMPLETION AND RESOURCE REQUIREMENTS

The priority for implementing the air quality surveillance program will, as a first consideration, meet the minimum federal requirements. The second consideration will be the performance of special studies needed to develop control strategies, especially for particulates.

7.1 TIMETABLE FOR COMPLETION

The minimum requirements call for the following array of sampling equipment in the State of Alaska:

	Number of Samplers			
Type of Sampler	Cook Inlet	Northern	South Central	South Eastern
Particulate				
High Volume	5	4	1	1
Tape	1	1		
Sulfur Dioxide				
Bubbler	1	1	1	3
Continuous				1
Carbon Monoxide				
Continuous		1		

Only the Cook Inlet Region currently has the equipment necessary to implement the minimum requirements immediately. All other instrumentation, with the exception of one high volume sampler and the bubbler in the Northern Alaska region (NASN) must be purchased.

Episode monitoring stations, which must be operational within one year after EPA approval of the implementation plan, include one high volume and one tape sampler in Anchorage and Fairbanks, one continuous CO analyzer in Fairbanks, and one continuous SO_2 analyzer in Ketchikan.

Since all 50 states will be operating on essentially the same timetable, there will be a significant demand for these instruments. The delivery time will be 150-180 days, and it normally takes at least 30 days of operation to bring a new instrument to smooth operation once it is started. All episode monitoring instrumentation will be ordered not less than seven months prior to the time that data is required from that instrument.

The balance of the minimum requirements system will become operational within the two-year time period defined as a regulatory requirement.

The proposed sampling system, including samplers for the special studies, increase the requirement to these totals (by owner):

	Tri-Borough	Fairbanks N. S.	State
Particulate			
High Volume	9	10	8
Andersen			2
Tape	1	1	
Dustfall	9	5	5
Sulfur Dioxide			
Bubbler	1	1	1
Continuous			
Carbon Monoxide			
Continuous		1	

With allowances for existing equipment and that already assigned to meeting the minimum requirements, the equipment to be purchased becomes:

	Cook Inlet	Fairbanks N. S.	State	Total
Particulate				
High Volume		6	6	12
Andersen			2	2
Dustfall	9	5	5	19

This equipment will be acquired before the end of calendar year 1972. The dustfall samplers will be constructed locally and are not a factor in the cost estimate.

7.2 MANPOWER

The experience of many air pollution control agencies indicates that much of the air quality surveillance effort can be accomplished by technicians, under the supervision and direction of professional staff members.* Based on this experience, manpower projections for the performance of the air quality surveillance task are:

	Program Level	
	Minimum	Proposed
Cook Inlet		
Engineer	1-1/4 time	1-1/2 time
Technician	1-1/2 time	1-full time
Local Assistance*	2	4
Fairbanks N.S.		
Engineer	1-1/3 time	1-1/2 time
Technician	1-3/4 time	1-full time
Local Assistance	0	1
State		
Engineer	1-1/4 time	1-1/2 time
Technician	1-1/2 time	2-full time
Local Assistance	3	4

*Local Assistance: A person to change high volume samples and/or bubblers once or twice a week.

*A more detailed discussion of these required man-hours is presented in the Resources Volume of this Report.

7.3 SURVEILLANCE EQUIPMENT ACQUISITION

The major equipment items which must be purchased to meet the minimum requirements are the continuous CO monitor for Fairbanks and the continuous SO_2 monitor for Ketchikan. The cost of these instruments, with a strip chart recorder and magnetic tape data acquisition system, is:

CO: Non-dispersive infrared, 0-100 ppm	
Basic instrument	$3500
Recorder	1000
Mag. tape unit	800
	$5300

SO_2: Flame photometric, linear output	
Basic instrument	$4500
Recorder	1000
Mag. tape unit	800
	$6300

In addition to these major items, two high volume samplers and two tape samplers are required to meet the minimum episode requirements. All episode instrumentation must be operational within one year after EPA approval of the implementation plan.

Spare parts and supplies must be purchased in order to keep the system operational, and an additional cost of 10% is used for estimated budgeting purposes.

The episode instrumentation requirement is:	
1 - CO analyzer @ $5300	$5300
1 - SO_2 analyzer @ $6300	6300
2 - HiVols @ $200	400
2 - Tape Samplers @$850	1700
	$13,700 + 10% = $15,070

This equipment requirement is reduced by one hi-vol (the NASN samplers in Anchorage) and by one tape sampler (currently in the Tri-Borough equipment inventory). All other instruments must be purchased at a cost of $13,915.

The remainder of the minimum equipment requirements must be operational within two years after EPA approval of the implementation plan:

8 - HiVols @ $200	$1,600
6 - Bubblers for SO_2 @ $475	2,850
	$4,450 + 10% = $4,895

This equipment requirement is reduced by one bubbler (NASN in Fairbanks), and by four hi-vols currently in the Tri-Borough equipment inventory, and by the NASN hi-vol in Fairbanks. The purchase cost for new instruments is $3795.

To expand the surveillance equipment inventory to meet the proposed system in the state, additional equipment must be constructed and/or purchased.

19 - Dustfall stations @ $30	$ 570
12 - HiVols @ $200	2400
2 - Andersen samplers @ $1200	2400
	$5370 + 10% = $5,424

In summary, the cost of additional surveillance equipment to conduct an adequate program in the State of Alaska is:

Equipment Use	All Purchased	With Allowance for Present Equipment
Episode	$15,070	$13,915
Balance of Minimum	4,895	3,795
Proposed	5,424	5,424
	$25,389	$23,134

All costs are based on F.O.B. manufacturer's plant.

High volume samplers and bubblers are available within two months after placement of a purchase order. The two continuous instruments will be in significant demand since all 50 states must meet the same time schedule for episode monitoring station installation. Delivery is estimated at 90-150 days for these instruments.